Digitized by the Internet Archive
in 2025

https://archive.org/details/bulletin-kentucky-agricultural-experiment-station-uky_1924_part-2

IMPERIAL MYCOLOGICAL
5 MAY 1938
INSTITUTE

THIRTY-SEVENTH ANNUAL REPORT

OF THE

# Agricultural Experiment Station

OF THE

## UNIVERSITY OF KENTUCKY

LEXINGTON, KY.

---

PART II

Bulletins 252 to 256

Circulars 32 to 34

---

1924

IMPERIAL BUREAU OF MYCOLOGY

THIRTY-SEVENTH ANNUAL REPORT

OF THE

# Agricultural Experiment Station

OF THE

## University of Kentucky

Lexington, Ky.

FOR THE YEAR 1924

Report of the Director

Meteorological Observations

Part I.

# EXPERIMENT STATION STAFF

**BOARD OF CONTROL**

Richard C. Stoll, Chairman, Lexington, Ky.
H. M. Froman, Lexington, Ky.
R. G. Gordon, Louisville, Ky.
Rainey T. Wells, Murray, Ky.
McHenry Rhoads, Frankfort, Ky.

Frank L. McVey, President — Thomas P. Cooper, Dean and Director

## ADMINISTRATION

T. P. Cooper, Director
D. H. Peak, Business Agent
O. L. Ginocchio, Secretary

## AGRONOMY

George Roberts, Head
E. J. Kinney, Assoc. Agronomist
P. E. Karraker, Asst. Agronomist
J. F. Freeman, Supt. Exp. Fields
W. D. Valleau, Plant Pathologist
**E. N. Fergus, Asst. Agronomist
J. B. Kelley, Agricultural Engineer
E. M. Johnson, Asst. in Agronomy

## ANIMAL HUSBANDRY GROUP

E. S. Good, Chairman
J. J. Hooper, Dairy Husbandry
W. S. Anderson, Horses
L. J. Horlacher, Beef Cattle, Sheep
E. J. Wilford, Swine, Meats
W. J. Harris, Beef Cattle
J. H. Martin, Poultry
J. W. Nutter, Dairyman
Amanda Harms, Asst. Path. Bact.
W. W. Dimock, Head, Vet. Science
Ethel M. Snyder, Lab. Assistant
E. A. Caslick, Asst. Veterinarian
D. A. Sanders, Assistant

## CHEMISTRY

A. M. Peter, Head
S. D. Averitt, Chemist
O. M. Shedd, Chemist
G. D. Buckner, Chemist
J. S. McHargue, Chemist
W. D. Iler, Asst. Chemist
D. J. Healy, Bacteriologist

## CREAMERY LICENSE SECTION

J. D. Foster, Inspector in Charge

## ENTOMOLOGY AND BOTANY

H. Garman, Head
Mary L. Didlake, Asst. Entomologist
H. H. Jewett, Research Asst. Ent.
Carrie Lee Hathaway, Seed Analyst
Marie Jackson, Seed Analyst

## FARM ECONOMICS

W. D. Nicholls, Head
O. B. Jesness, Chief, Sec. Markets
Dana G. Card, Asst. Marketing
W. G. Finn, Farm Management
*E. L. Langsford
*Z. L. Galloway

## FEED CONTROL

J. D. Turner, Head
H. D. Spears, Chemist
W. G. Terrell, Inspector
Fred Fitschen, Inspector
P. H. Senn, Microscopist

## FERTILIZER CONTROL

H. E. Curtis, Head
Harry Allen, Chemist
Lelah Gault, Asst. Chemist
R. E. Tolle, Inspector

## HORTICULTURE

C. W. Mathews, Head
**A. J. Olney, Asst.
C. S. Waltman, Asst.

## PUBLIC SERVICE LABORATORY

L. A. Brown, Head
E. J. Gott, Bacteriologist
A. L. Meader, Asst. Chemist
James H. Martin, Asst. Chemist
E. K. Borman, Asst. Bacteriologist

## ROBINSON SUBSTATION
(Quicksand, Ky.)

R. W. Jones, Superintendent
C. H. Burrage, Forester

## WESTERN KY. SUBSTATION
(Princeton, Ky.)

S. J. Lowry, Superintendent

*Assigned by the U. S. Department of Agriculture.
**On sabbatical leave.

## LETTER OF TRANSMITTAL

*To His Excellency, Hon. William J. Fields, Governor of Kentucky:*

**Sir:**—In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations in connection with the Agricultural Colleges established in the several states under the provision of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862," I herewith submit the Thirty-seventh Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS COOPER, *Director.*

January 1, 1925.

## UNIVERSITY OF KENTUCKY

**Lexington, Ky.**

---

### Board of Trustees

Hon. William J. Fields, Governor, Chairman, *ex officio*
McHenry Rhoads, Supt. of Public Instruction, *ex officio*
Clell Coleman, Commissioner of Agriculture, *ex officio*
H. M. Froman, Lexington, Fayette County.
Richard P. Ernst, Covington, Kenton County.
Robert G. Gordon, Louisville, Jefferson County.
Richard C. Stoll, Lexington, Fayette County.
Rainey T. Wells, Murray, Calloway County.
James W. Turner, Paintsville, Johnson County.
Frank McKee, Versailles, Woodford County.
W. H. Grady, Louisville, Jefferson County.
Howard P. Ingels, 14 Wall St., New York, N. Y.
L. M. Lebus, Cynthiana, Harrison County
R. J. Bassett, Leitchfield, Grayson County.
Louis Hillenmeyer, Lexington, Fayette County.

# ANNUAL REPORT

of the

# DIRECTOR OF THE

# KENTUCKY AGRICULTURAL EXPERIMENT STATION

For the Year 1924

Excellent progress has been made by the Experiment Station during 1924, and the results of many successful experimental projects have been made available. Each year gives evidence of increased use upon the part of farmers of the results of the station's work and of more attention paid to the information issued by it.

As extension work has become more strongly organized, the applications of experimental work have increased. Field agents not only carry the results of experimental evidence to many farmers, but in return bring to the Experiment Station the immediate needs of agriculture.

As has been pointed out in previous reports, the funds made available for the work of the Experiment Station become an investment in agricultural progress. In this day of increased agricultural competition and of an almost constant succession of new problems of soil, plant and animal life, farm organization and the economic aspects of agriculture, research and investigation offer the only method of effective progress. The individual farmer can not afford as can the large corporation to carry experimental projects. State and nation, however, may support investigation and offer its results for adaptation. Kentucky's agriculture will progress as the results of investigation are used.

The year 1924 marks a milestone in the progress of the Experiment Station. The legislature of this year established

two branches of the Experiment Station and appropriated the necessary funds for their operation. One branch has been located at Princeton and is designated as the Western Kentucky Substation; the other branch is located at Quicksand, on lands in Breathitt, Knott and Perry counties, donated to the University of Kentucky, and is known as the Robinson Substation.

A need for the added organization of the Experiment Station is apparent. Mountain agriculture, the prosecution of work in forestry and the varied demonstrations of the possibilities of eastern Kentucky can only be carried on in this region. Similarly the agricultural problems of western Kentucky can only be partially solved in the Bluegrass. Soils, dark tobacco, pasture grasses and small fruits present problems which in their practical application must be solved in western Kentucky.

**Western Kentucky Substation.** The Western Kentucky Substation was established in Caldwell County by an act initiated by the Honorable T. H. King. Four hundred acres of land situated about one mile from the city limits of Princeton were selected by the director of the Experiment Station and donated to the University for the purposes of a substation by the citizens of Caldwell county. The land selected is typical of extensive areas in western Kentucky. Geologically, it represents the Chester sandstone formation, consisting of almost two thousand square miles, lying in a semicircle around the western coal field, and the Mammoth Cave limestone formation, consisting of almost six thousand square miles, lying in a semicircle adjacent to the Chester sandstone.

It is anticipated that much of the horticultural work of the Experiment Station will be carried on at this farm, and also that extensive experiments in tobacco, grasses for pasture and forage, and systems of effective soil building will be developed.

The deed for the land was received in November, 1924. Organization of the substation was undertaken early in December, a superintendent appointed and operations preparatory to the work for 1925 begun.

**Robinson Substation.** The Robinson Substation, established on a tract of approximately fifteen thousand acres of land in Breathitt, Perry and Knott counties, was deeded to the University in October, 1923, for the conduct of agricultural experiment work and for the practical demonstration of reforestation. These lands were donated by Mr. E. O. Robinson of Fort Thomas, Kentucky, accepted by the legislature of 1924, and a sub experiment station established thereon in accordance with an act introduced by Honorable W. J. Howard.

In May, 1924, the property holdings of the University of Kentucky were augmented by a deed to ten acres of land comprising practically the entire town site of Quicksand, in which are located the headquarters and other buildings of the substation and which forms the entrance to the larger holdings. This was the gift of Mr. Miles Back of Quicksand, Kentucky, who "desired to give this land to be of benefit to the people of the mountain districts of Kentucky."

The lands of the Robinson Substation are somewhat scattered, altho approximately fourteen thousand acres lie in one body, principally on Buckhorn Creek, Clemon's, Cole's and Lewis' forks. This area has the characteristic topography of large parts of eastern Kentucky. The altitudes are relatively low, approximating one thousand to twelve hundred feet. The topography is characterized by steep hillsides or ridges and narrow valleys, the ridges rising from 300 to 500 feet above the valley floors. The soils are derived from sandstone formation. These lands have been logged off during the past fifteen years, a large part of the acreage having been logged within the past six or seven years. The original timber growth on the land consisted largely of yellow poplar, white oak, hemlock, red oak, red maple, hard maple and some beech. The crest of the ridges grew some yellow and black pine and yellow poplar, much of which, however, was cut out many years ago. As a whole, this area may be considered typical of the many sections of eastern Kentucky and therefore the results obtained either in forestry or agriculture may be applied to a very large area of the state.

The funds becoming available June 19, 1924, a superintendent was appointed, the station organized and work begun. Attention was first given to the remodeling of existing facilities and to the clearing and cleaning of the grounds on the ten-acre tract at Quicksand. This area, as well as a part of the farm had been utilized for building sites. Thirty-five small houses were moved by contract, and twenty buildings were torn down. These buildings varied from small structures to a large repair and machine shop and saw mill, and were removed to ultimately provide sites for new buildings which will fit the purposes of the station. In addition to this work of removal and clearing, farm fences have been built, certain steep land on the farm has been terraced, a drain ditch constructed and a poultry house and stock barn have been erected. Projects are under way in agronomy, horticulture, dairying, poultry and swine.

A forester was appointed and reported for duty August 25, 1924. His efforts thus far have been directed mainly toward retracing and establishing boundary lines and corners, organizing fire protection and making a topographic map of the farm and headquarters tract. A quarter of an acre of black walnut has been planted by direct seeding and will be followed by more planting later.

**Statistical Compilations and Comparisons.** Statistics were compiled and comparisons made in an endeavor to ascertain what commodities are produced in the state in larger amounts than used by its population and for what products the state's production is less than its requirement. Tobacco naturally heads the list of commodities produced in excess of local need. The livestock produced is more than that required for home use, and the same is true of poultry and eggs. Large quantities of hay and concentrated feeds are shipped into Kentucky. The production of wool, potatoes and wheat is less than the consumption. The amount of dairy products consumed probably is somewhat larger than the production.

Comparisons were made on the basis of existing statistical data and calculation based thereon of the sales of products

from farms for different areas of the state. For this purpose, the 120 counties in the state were grouped into districts as follow:

| | No. of Counties | No. of Farms |
|---|---|---|
| North Central Region (Bluegrass) | 38 | 73,374 |
| Southwestern Agricultural Region | 10 | 26,678 |
| Purchase | 8 | 22,126 |
| Western Coal Fields | 9 | 25,856 |
| West Central Agricultural Region | 21 | 51,049 |
| Mountains | 34 | 71,543 |

These sections ranked in the above order when compared with respect to the gross sales per farm, the mountain farmer's cash receipts being only 20 per cent. of those in the first named group.

When compared as to gross sales per acre of all land in farms, the above order was maintained except that the Purchase region moved up to second place, the Mountain selling about 18 per cent. as much per acre as the North Central (bluegrass) region.

In looking for the cause of this consistency in order of cash sales in the six sections they were compared as to percentage of farm land improved. Again the first order was maintained except that the Purchase took second place and the Southwestern Agricultural Region third. This latter order was maintained also when compared as to sales per acre of improved land in farm.

The size of farms cannot be responsible for this order of the sections classified as to farm sales, since the North Central Region and the Purchase have the smallest farms, while the Southwestern Agricultural Region has the largest farms.

The value of farm lands per acre (census data) reflects the economic returns. The arrangement according to value is: North Central Region, first; the Purchase, second; the Western Coal Field, third (probably due in part to underlying coal); the Southwestern Agricultural Region, fourth; the West Central Agricultural Region, fifth, and the Mountains, sixth.

**Marketing Tobacco.** Much attention has been paid during the year to the market situation with respect to tobacco, par-

ticularly the burley type. Trends in production, consumption and accumulation of stocks, have been studied. Summaries of the information assembled and conclusions drawn therefrom have been given wide publicity with the purpose of making them available to the growers for their use in planning their production. The survey of the situation based on statistical information available shows that the production of burley tobacco has been extended more rapidly than has the market demand for this type, with the consequence that the stocks on hand have become larger than ever before. Wide dissemination was given these facts early in the year and the burley growers were repeatedly urged to revise their planting intentions for 1924, so that a reduced acreage would be devoted to this crop.

Estimates show that the burley crop of 1923, amounting to over 326 million pounds, was the largest crop of burley ever produced, the next largest being that of 1920, which was estimated at about 315 million pounds. The 1923 crop was over 50 million pounds greater than that of 1922, and over 100 million pounds larger than the crop of 1921. That the increased production has gone mainly into the stocks on hand and not into consumption is shown by the stocks on hand reported by dealers and manufacturers (including the Burley Tobacco Growers' Cooperative Association). On October 1, 1924, these stocks totalled over 428 million pounds, compared with stocks of about 342 million pounds on the same date in 1923 and 280 million in 1922. The largest total of these reports for October 1, previous to 1923, was in 1921 following the large crop of 1920, when 324 million pounds were reported.

The consumption data show that the manufacture of cigarettes has been steadily increasing, while practically no change has taken place in the amount of tobacco and snuff manufactured in the last two or three years. The increasing popularity of cigarettes has led to the suggestion that this furnishes an outlet for large quantities of tobacco leaf. However only a little over 200 million pounds of leaf were required for cigarette manufacture in 1923. When it is remembered that

only a portion of the burley crop is used for cigarettes, it is easily seen that a large increase in cigarette consumption can take place without providing an outlet for any considerable part of the surplus that has resulted from the overexpansion in production.

**Poultry and Egg Marketing.** A considerable number of produce dealers and country storekeepers have been visited for the purpose of obtaining information regarding the methods employed by them in handling and marketing poultry and eggs. Quality is an important factor in marketing eggs and unless eggs are purchased from farmers on a grade basis, the incentive to strive for high quality is lacking to a large extent. Attention, therefore, has been paid to the possibilities, among other things, of adopting some plan of grading eggs for this purpose. Considerable interest in the development of a plan of this kind is evident among the larger egg buyers in the state. The greatest obstacle seems to be the difficulty of obtaining the assured cooperation of a sufficient proportion of the buying trade to insure the plan's success.

**Metabolism of the Chicken and Other Animals.** In the experiment on the effect of calcium carbonate in the diet of hens, the hatchability of the eggs from hens confined to the house, receiving the customary ration of grain and mash, with grit and some green food, but no shell, was reduced to zero by the middle of April. On May 1, and thereafter, oystershell was allowed these hens freely, whereupon the hatchability of their eggs increased to 36 per cent. by the middle of June. On the other hand, hens treated in the same way, except that they received oystershell freely, produced eggs in April, the hatchability of which was 57 per cent. After shell had been withheld from these hens, beginning May 1, the hatchability of their eggs fell to about 5 per cent. Another lot of hens, similarly housed and fed, but allowed a free range, receiving shell freely from November 1 to May 1, produced eggs before May 1 having a higher hatchability in two settings out of three than those produced by the hens without range but receiving shell. After shell had been withheld from the hens on range, the hatchabil-

ity of their eggs decreased strikingly, but not as much as happened in the case of the hens confined to the house under a like restriction. Work under this project reported in Bulletins 250 and 252, has demonstrated the importance of calcium carbonate in the diet of laying hens. From the standpoint of egg production the present experiment proves its importance in the diet of the breeding flock and further shows that even when hens are allowed a fairly large grass range, they may not get enough calcium carbonate to maintain the hatchability of their eggs unless it is given them.

The chemical analyses of the droppings of the hens in this experiment showed a considerable proportion of calcium carbonate in the droppings when the hens received shell; whereas in the absence of shell, the droppings were free from carbonate, though containing calcium in the form of phosphate. The droppings from the hens having range contained much larger proportions of siliceous matter and iron than the others, obviously derived from the soil of the range. The proportion of mineral matter increased when these hens were deprived of shell, presumably because they then picked up more mineral particles in their effort to gain the needed calcium carbonate.

**Chemical Study of the Oviduct of the Hen.** A chemical study of the oviduct of the hen showed that the actual amount of calcium in the walls of the oviduct of a laying hen is small as compared with the quantity of calcium carbonate which is deposited as shell in a few hours. The actual amount of calcium is less during the resting stage, however, than while the hen is laying. The apparent diminution of the proportion of calcium and increase of the proportion of phosphorus, as the resting stage is approached, is interesting and suggestive.

**Mode of Transference of Calcium from Shell of Hen's Egg to Embryo during Incubation.** Experiments in a study of the mode of transference of calcium carbonate from the eggshell to the growing embryo during incubation show that either water or egg white, saturated with carbon dioxid and allowed to stand 24 hours in an eggshell in which the membranes remain in their natural condition, acquires an appreciable

amount of calcium carbonate. Presumably, the carbon dioxid in solution in water reaches the shell by diffusion through the membranes and there forms calcium bicarbonate in solution, which diffuses back into the contents of the shells. In this way the growing embryo may obtain the needed calcium above that already contained in the white and yolk.

**Feeding Various Forms of Milk to Laying Hens.** The feeding experiments with White Wyandottes in which the condensed and dried forms of buttermilk were compared with sour skim milk and meat scrap were concluded this year. The winter and yearly egg production of the pens receiving condensed and dried buttermilk are given in the following table:

| Pen | Ration Fed (Grain uniform in all pens) | Egg Production Per Hen | | | | | | Average Winter |
|---|---|---|---|---|---|---|---|---|
| | | 1921-22 | | 1922-23 | | 1923-24 | | |
| | | Winter | Year | Winter | 8 Mos. | Winter | Year | |
| 4 | Mash and condensed buttermilk | 34 | 145 | 31 | 102 | 45 | 163 | 37 |
| 5 | Condensed buttermilk only | 40 | 154 | 28 | 88 | 49 | 164 | 39 |
| 6 | Mash with dried buttermilk | — | — | 48 | 124 | 41 | 149 | 45 |

A summary of the three years' work shows that there is no value in the addition of a dry mash of ground grains and mill feed to a ration of grain and condensed buttermilk. This bears out the previous experimental work in which the addition of such a mash to a ration of grain and sour skim-milk proved of no value. If the high protein feed is omitted from the dry mash, the entire mash may just as well be omitted from the poultry ration.

**A Comparison of the Common Grains as Supplements to Skim-Milk.** The food consumption per hen, for the past two years, in each of the pens of Barred Plymouth Rocks, comparing corn, wheat and oats in various proportion as supplements to sour skim-milk, together with the winter and yearly egg production and feed cost, is given in the following table:

| Pen | Grain, Lbs. | | Skim-milk, Gals. | | Mash, Lbs. | Eggs Per Hen | | Cost of Feed | |
|---|---|---|---|---|---|---|---|---|---|
| | 1922-23 | 1923-24 | 1922-23 | 1923-24 | 1923-24 | Winter | Year | Per Hen | Per Doz. Eggs |
| *14 Corn | 70 | 72 | 12.8 | 14.6 | | 49 | 162 | $1.65 | 12.2 cts. |
| *15 Corn-oats | 75 | 74 | 13.1 | 18.3 | | 58 | 164 | 1.82 | 13.4 cts. |
| *16 Corn-wheat | 73 | 67 | 14. | 14.4 | | 66 | 178 | 1.77 | 12.6 cts. |
| *17 Corn-oats-wheat | 73 | 63 | 12.3 | 17. | | 61 | 175 | 1.73 | 11.9 cts. |
| **18 Corn-wheat-gr. milk | .... | 64 | ..... | 14.9 lbs.† | | 68 | 168 | 2.25 | 16.1 cts. |
| **19 Corn-wheat-10% M. S. | .... | 59 | ..... | 16.1 | 16.2 | 59 | 197 | 1.85 | 11.2 cts. |

*Egg production average for 2 years.
**Egg production average for 1 year only.
†Granulated buttermilk.

Two new pens were added to this experiment this year. Pen 18 received the same grain mixture as pen 16, but instead of sour skim-milk, this pen was fed granulated buttermilk at the rate of 1 pound daily to 25 hens. Granulated buttermilk is a commercial product similar to dried buttermilk, but of granular form, and the birds ate it readily from an open trough. Pen 19 received the same grain mixture as pen 16, both pens having skim-milk available at all times. In addition, the birds in pen 19 received a mash of bran, 40 per cent.; shorts 40 per cent.; corn meal 10 per cent. and meat scrap 10 per cent. This pen was added to determine if there is any advantage in the use of a dry mash when the birds receive all the milk they will drink. Since previous work showed that there was no advantage in adding a dry mash containing no high protein feed, 10 per cent. meat scrap was added to the mash in pen 19.

The table shows that very satisfactory egg production can be secured without the use of a dry mash when sour skim-milk is available at all times as a source of protein and is used to supplement the grain ration. There seems to be little difference in the production, or the cost of producing eggs with the different proportions of grain fed. As corn is normally abundant on Kentucky farms and comparatively cheap, it is logical to build the ration around corn as a base. Whether or not wheat should be added to the grain mixture would depend upon its availability and price. If oats are available and of good quality, weighing better than 32 pounds to the bushel, they can be used in the grain mixture with satisfaction.

The production in pen 19 would indicate that maximum production can best be secured by the use of both a dry mash, containing a high protein feed, and milk in some form. The increased production of pen 19 over pen 16 may largely be accounted for by the addition of a mash containing 10 per cent. meat scrap. It should be noted that there was little difference in the grain and milk consumption in pens 16 and 19, whereas pen 19 consumed, in addition, the dry mash at the rate of 16 pounds per bird for the year. Although the results from pen 19 for the first year are not conclusive, it may be safely

inferred that if milk is available for the laying flock, it would still be advisable to feed a mash containing approximately 10 per cent. meat scrap or tankage. If the supply of milk must be restricted, the amount of animal protein in the mash may be increased. Without the mash, very satisfactory egg production can be secured from grain and milk only, but for maximum production a combination of both is advisable.

**Poultry Range Versus Confinement During Winter Months.** In a trial to determine whether or not the laying flock should be allowed out-of-doors during the winter months, one hundred birds of the breeds listed below were placed in each pen. One pen was confined to a 20x20 shed-roof house, from November 1 to March 1. The range pen, in a house identical to that of the confined pen, was confined to the house only on stormy days, which means that the birds were out-of-doors at least five or six days of each week. The average egg production through the four winter months of the birds in the two pens is given in the following table:

Production November 1 to February 29.

| Breed | Confined Pen | Range Pen | Advantage of Range |
|---|---|---|---|
| Leghorn pullets | | | |
| Number of birds | 61 | 59 | |
| Average production | 40 eggs | 51 eggs | 11 eggs |
| Leghorn yearlings | | | |
| Number of birds | 10 | 11 | |
| Average production | 47 eggs | 48 eggs | 1 egg |
| S. C. Red pullets | | | |
| Number of birds | 10 | 9 | |
| Average production | 32 eggs | 42 eggs | 10 eggs |
| Barred Rock pullets | | | |
| Number of birds | 14 | 13 | |
| Average production | 50 eggs | 45 eggs | —5 eggs |
| Total number all birds | 95 | 92 | |
| Average production | 42 eggs | 49 eggs | 7 eggs |

The table shows that the birds allowed out in good weather produced an average of 7 eggs more per bird during the four winter months. In every breed, the birds in the range pen outlayed their competitors in the confined pen, except in the case of the Barred Rock pullets. A study of the monthly production shows that the Leghorn pullets in the range pen outlayed those in the confined pen during each of the four winter months. The Leghorn yearlings which were confined outlayed those in the range pen in every month except November. However, the hens in the range pen more than doubled the production of the confined pen during November. The Red pullets in the range outlayed those in the confined pen every month. The Barred Rock pullets in the confined pen outlayed those on range during every month except February.

This trial indicates that with the mild winter in most parts of Kentucky, it is advisable to allow the laying flock, as well as the breeding pen, out-of-doors on all pleasant days.

**The Occurrence and Distribution of Manganese in Plants.** This investigation has been modified to include the effect of manganese, copper, zinc, cobalt and nickel on the growth of plants, and manganese, copper and zinc in animal metabolism. Sand culture experiments, including one crop each of peas, tomato and buckwheat plants, in each of 42 pots, were carried on for the purpose of determining whether copper, zinc, nickel or cobalt may perform the same function as manganese in plants. The results indicate that neither of these metals takes the place of manganese, but that both copper and zinc perform important functions in connection with manganese, in the processes of fructification.

Much time has been given to preliminary feeding experiments with albino rats, to determine if copper, manganese and zinc function in the metabolism of the animal. Analyses show that these metals are present in the young rats at birth, suggesting that they may have some important function during the embryonic stages.

Considerable difficulty was found in preparing food for the rats so nearly free from the metals in question as to be suit-

able for use in this experiment. Much time has been given to this branch of the problem, with only fair success. To further guard against the access of undesirable metals, glass cages with aluminum fittings have been constructed, which seem to be more satisfactory than the all-metal cages.

The experiments show that rats tolerate small amounts of inorganic compounds of the metals in question, in their food, and the rats receiving a specially prepared food to which the metallic compounds had been added, were more thrifty and made a better growth than those receiving the same kind of prepared food without this addition.

The conclusions reached in the investigations may be summarized as follows: Fertile soils contain, beside iron and manganese, also small quantities of copper and zinc. The tissues and organs of animals contain all these metals. The animal at birth contains them in relatively large proportion, which suggests that these elements are necessary in the embryonic stages. The occurrence of these elements in relatively greater concentration in the more vital organs of plants and animals points to their importance in the metabolic processes of both plants and animals. The presence of these elements in relatively high concentration in those organs and secretions of plants and animals possessing marked vitamin potency is very significant. Normal milk of the cow contains small but appreciable amounts of copper, manganese and zinc. The colostrum contains several times as much of these metals as the normal milk. From the results obtained with whole milk, butterfat, skim-milk and other substances containing vitamins, it appears that copper is associated with fat-soluble A, manganese with water- soluble B, and zinc with vitamin C. The evidence obtained seems to show that copper, manganese and zinc, in connection with iron, are of fundamental importance in the metabolism of both plants and animals.

**A New Microorganism.** A microorganism, *Encapsulatus genitalium* (*inguinalis*) from the genital tract of mares has been isolated and identified. This organism is the cause of a serious form of inflammation of the genital tract. It becomes

of added importance because it is believed this form of infection is one easily transmissible by the stallion at the time of service. In treating cases of genital infection of mares, the operator must use great care to prevent the carrying of this infection to other mares under treatment. So far as can be ascertained from veterinary literature, this is the first identification of this organism as a cause of genital infection in mares. The discovery of this organism gives a new classification of general infection and necessitates added precaution in diagnosis and treatment.

**Sterility in Mares.** The results of observations made during the year show that inflammation of the womb, or metritis, due to infection, is the most common and most serious cause of sterility or barrenness in mares. A great variety of antiseptic medicinal agents have been tried in the treatment of metritis, but none is a specific in its cure. Experience indicates that it is impossible to effect a cure in a majority of the mares affected with infectious metritis. Because of the fact that it is impossible to cure so many of the mares suffering with infectious metritis and because of the time required to effect a cure in those that respond to treatment, efforts have been directed to methods of prevention and to a system of handling brood mares that will enable the determination of the presence or absence of infection in barren mares early in the fall. All barren mares found to be affected with metritis are put on treatment in the fall and, in some cases, may be gotten in condition to breed the following spring. The more persistent and chronic cases, which do not respond readily to treatment, should not be bred the following spring, but the treatment should be continued with the idea of getting the mares in condition to breed the next season.

The two most common and most serious forms of infection of the genital tract of mares are *Streptococcus genitalium* and the *Encapsulatus genitalium*. Both organisms cause a serious form of inflammation of the womb, or metritis, and are exceedingly difficult to overcome, once having become established in the tissues and membranes of the genital tract.

**Sex of Calves Carried Beyond Usual Gestation Period.** The livestock breeder generally assumes that a calf carried for longer than the usual gestation period will usually be of the male sex. To determine whether there is basis for this belief, a study was made of the breeding records kept in connection with the dairy herd at this Station, these records covering a period of approximately twenty years. From these data only gestation periods exceeding the usual period by at least five days were used. It was found that forty-eight cows, exceeding the usual gestation period from five to seventeen days, produced 29 bulls (60 per cent.) and 19 heifers (40 per cent.) or a ratio of 6 bulls to 4 heifers.

**Milk and Butterfat Production of Jersey Heifers.** In an attempt to determine the age at which it is best to begin milking a Jersey heifer, all official milk and butterfat test records made by Jersey heifers and printed in the Register of Merit volume for 1922 have been tabulated and studied. From this study, it was found that the greater number of heifers began tests at 24 months of age, although approximately as many tests were begun when the heifers reached the respective ages of 23, 25, 26 and 27 months. However, the maximum production was attained by heifers beginning tests at 28 months.

**Isolation and Cultivation of Specific Microorganism of Hog Cholera.** In the experiments to isolate and cultivate the causative agent of hog cholera, hog tissues were extracted with buffered distilled water at 4 degrees C. for eight days. Such extracts were made from fresh hog kidney, spleen and liver tissues, and enriched with normal hog serum, fresh whey, glucose and fresh egg-yolk. Such enriched extracts were inoculated with phenolated commercial virus, the reaction adjusted to pH 7.4, and filtered through sterile, tested F bougies, and the filtrate distributed among 12 to 18 sterile test tubes. The filtrate was cultivated at 37 degrees C., with and without oxygen. After 72 hours at 37 degrees C. in air a characteristic microbe developed in the liver extract virus culture. This microbe, which has been numbered 169[2], is a very small rod coccus, 0.3x0.75 micron, occurring in pairs or short chains, and stain-

ing well with anilin gentian violet. It did not develop in the kidney, nor in the spleen extract virus cultures. This microbe was subcultured in liver extract enriched medium, growing, however, less vigorously with each subculture, growth ceasing in the ninth subculture. Microbe 169[2] failed to grow at 37 degrees C. in the air in nutrient broth, 1 per cent. dextrose agar, whey, egg-yolk, glucose, buffered water; the latter plus 10 per cent. liver extract; whey, egg-yolk, glucose, buffered water plus 7.5 per cent. normal hog serum; the latter plus 10 per cent. liver extract.

A microbe closely resembling 169[2] was demonstrated in fresh hog cholera virus. Attempts to fix complement with microbe 169[2] were unsuccessful. Attempts to again isolate microbe 169[2] from virus have so far failed.

A bacteriophage very active against *Salonella suipestifer* has been isolated from hog feces, and a study will be made of the possible relationship between bacteriophage and hog cholera virus.

**Hog Feeding Experiments.** Results this year practically parallel those of last year in the testing of mineral mixtures and tankage as supplements to corn for hogging down. Four one-acre plots of corn were used. Lot 3 was supplemented with a mineral mixture of 3 parts bone marrow meal, 1 part limestone and 1 part salt; lot 4, with tankage; lot 5 with a mineral mixture of 3 parts ground rock phosphate, 1 part salt and 1 part limestone; lot 6, corn alone.

Tankage gave the largest net return. The pork produced in lot 3 was 630 pounds; lot 4, 670 pounds; lot 5, 520 pounds; lot 6, 420 pounds. The net returns with hogs at $11 were: Lot 3, $49.42; lot 4, $51.54; lot 5, $37.68; lot 6, $32.30. Based on estimated yields of corn, lot 3 gave better results than lot 4, producing 12.87 pounds of pork per bushel of corn, while the tankage lot produced only 10.17 pounds of pork per bushel. Lot 5 produced 10.83 and lot 6, 8.86 pounds of pork per bushel of corn. Although lots 3 and 5 produced a greater number of pounds of pork per bushel of corn, lot 4, the tankage lot, returned the greatest profit. This indicates that mineral mix-

tures will give fairly good results in comparison with tankage as a supplement to corn.

**Feeding Breeding Ewes.** During the breeding season, and preceding the lambing period, the Station flock of forty-five ewes was fed a ration of equal parts, by weight, of oats and bran, in addition to alfalfa hay and bluegrass pasture. The nutritive ratio of the grain and hay ration fed was 1:3. A 155 per cent. lamb crop was dropped. The ewes gained in weight and all wintered in good health, which is noteworthy, since farmers in all sections of the state lost from eight to fifteen per cent. of their ewes.

For the past six years, records have been kept on the feeding of two hundred and fifty ewes during the period of pregnancy and in practically every case where the ration has contained ample protein, the ewes have come through the winter in good condition and a large lamb crop has been produced. Clover or alfalfa hay has proved to be the best source of protein. Wheat straw and silage did not prove satisfactory unless fed in conjunction with a protein feed.

**Fattening Spring Lambs.** Beginning June 2, 1924, the entire crop of Station spring lambs was divided into two lots, one lot on blue grass pasture and the other on a mixture of rape and oats. In addition, the lambs in each lot were permitted to nurse the ewes and were fed a grain mixture consisting of ten pounds rolled oats, two pounds bran and one pound pea-size linseed meal. All the pasture was in excellent condition, and the rape and oats were about ten inches high when the experiment began. The lambs on bluegrass pasture made an average gain of 11.8 pounds in twenty-eight days. The lambs on rape and oats pasture made an average gain of 12½ pounds in twenty-eight days. This is only a very slight advantage in favor of rape and oats, but an important consideration is that the nineteen lambs had access to only one acre of rape and oats, but the lambs on bluegrass pasture had access to all paturage required.

**Fattening Late Native Lambs.** The first year's trial to determine the feasibility of fattening second and cull native

lambs was completed. Thirty-two second-grade native lambs were purchased at ten cents a pound. Half of these were drenched once with copper sulfate to control stomach worm. Four of the weaker lambs died from hemorrhagic septicemia, and the remaining twenty-eight were divided into two lots of fourteen each. One lot was fed an average daily ration of 1.24 pounds shelled corn and 1.26 pounds alfalfa hay. These lambs gained .215 pound daily at a cost of 15c a pound. The second lot was fed an average daily ration of 1.08 pounds shelled corn, .27 pounds cottonseed meal and 1.23 pounds of alfalfa hay. These lambs gained .197 pound daily at a cost of 18 cents a pound. Both lots sold at $14.10 a hundred. The profit on lot 1 was $2.53 a lamb, and on lot 2, $2.17 a lamb. The undrenched lambs in this trial gained more than the drenched lambs, probably due to their superior vigor at the beginning of the trial.

**Steer Feeding.** The steer feeding experiment begun November 15, 1923, and completed April 17, 1924, inclusive, concluded three consecutive tests of the rapidity and economy of gains made by steers fed silage throughout the entire feeding period as compared with steers having a legume hay substituted for silage near the end of the feeding period.

No corn was fed either lot for the first four weeks. In this test, it was found that steers made an average daily gain of 1.88 pound on an average daily ration of 15.9 pounds of broken ear corn (127 days) 2.62 pounds of cottonseed meal, 39.12 pounds of silage (110 days), 9.18 pounds of alfalfa hay (51 days), and 1.78 pounds of wheat straw. The steers fed silage throughout the entire feeding period and no alfalfa hay, made an average gain of 1.77 pounds daily on an average daily ration of 15.5 pounds broken ear corn (127 days), 3.1 pounds cottonseed meal, 34.18 pounds of corn silage and 1.71 pounds of wheat straw. The necessary selling price per hundred weight for the lot in which silage was substituted with alfalfa hay was $9.49 and for the lot which received silage throughout the test, $9.56. Even tho the lot in which alfalfa hay was substituted for silage made a little larger gain at a cost

of 89 cents less per hundredweight, the lot receiving silage thruout the period was valued by a committee of experts at 20 cents more per hundredweight, due to a better appearance, netting a profit, crediting pork, of $7.22 per steer, while the other lot netted a profit, pork credited, of $5.58 per steer. The lot receiving silage thruout the feeding period had shed its hair to a greater extent than the other lot and appeared to have a higher finish, hence the higher price per hundredweight.

The profit and loss per steer on the two systems of feeding for each of the three experiments, pork credited, follows:

| | Substitution of legume hay for silage near end of feeding period | Silage fed thruout the experiment |
|---|---|---|
| Profit per steer, 1922 | $9.28 | $12.42 |
| Loss per steer, 1923 | 5.96 | 5.13 |
| Profit per steer, 1924 | 5.58 | 7.22 |

While, as a whole, the results have not been as good where the substitution was made, yet the difference in favor of continuous feeding of silage has not been large and in the year in which a loss occurred, this loss was only slightly greater in the lot receiving a legume hay. In two of the experiments, the steers receiving the hay made the greater gains. These experiments show that it is not necessary to sell half fat steers where the silage gives out if they can be supplied with a legume hay until finished.

**Study of the Cost and Returns from Bluegrass.** Detailed records were kept on 2770 acres of bluegrass pasture on 15 farms in Fayette, Scott, Bourbon and Clark Counties. The bluegrass areas on these farms ranged from 47 to 528 acres. The returns were measured in pounds of gain put on beef cattle and in bushels of bluegrass seed.

The gains put on beef cattle on the 2770 acres averaged 573 pounds per acre for the season. The average bluegrass seed yield was 6½ bushels per acre. The net value of the gains put on the cattle above all costs was $5.53 per acre.

The net value of bluegrass seed above all costs was $6.45 per acre. The average net gain from other stock on the pasture was 3 cents per acre. The total average net returns per acre were $12.01, or about 6 per cent. net on land in pasture, at a valuation of $200 per acre.

**Farm Business Analysis.** Business analysis records previously obtained on 241 farms in Mason and Fleming Counties were compiled during the year and brought out some facts having a vital bearing on the problem of increasing efficiency and securing greater profits on farms. A marked difference in net earnings on these farms was shown. The 241 farmers averaged $1,029 as wages for their labor and management for the year. The most profitable 15 farms averaged $3,203. The least profitable 15 farms averaged minus $807; that is, these farms failed by that amount to pay expenses and interest on investment. The study showed the most important factors determining profits were:

1. Effective control of expenses, as measured by the percentage of total expenses to total receipts.
2. Labor efficiency, as indicated by the amount of productive work accomplished per man.
3. A good volume of receipts per 100 acres of land.
4. Good crop yields.
5. Good returns per livestock unit.
6. Good quality of tobacco, as indicated by the price received per pound.
7. Good diversity of enterprises and a well-balanced business.

**Cost of Producing Strawberries.** Data upon the cost of producing strawberries were secured on 60 farms in Christian County. The study has brought out the fact that the variations in returns for different growers are due chiefly to difference in yield. Yields in turn are found to be largely influenced by the methods used in cultivating and harvesting the crop, together with the farmer's ability to secure workers to handle the crop during harvesting season. Growers with small acreages showed better returns than those with larger acreages.

**A Method for Finding the Place of Strawberries in the Farming Scheme.** A study was made of the labor require-

ments of the strawberry crop and of other farm crops, with the view of determining the effect which the introduction of one or more acres of strawberries into the farm scheme would have on the labor program. A schedule was worked out showing the effect of substituting three acres of strawberries for one acre of tobacco and three acres of corn, and the fact was brought out that this substitution would fit in well with the farm-labor program, where conditions are favorable for marketing strawberries, and that in many cases it would enable the farmer to increase his net farm profits.

A method for finding the place of strawberries in the farming scheme for any particular farm is shown in the following tables:

TABLE 1.

Average cost of producing strawberries and average income.

| | |
|---|---|
| ⅓ plant cost one acre (4,500@$3.50) | $5.25 |
| ⅓ fertilizer cost (400 lbs.@$1.50) | 2.00 |
| Straw for mulching—¾ ton@$9 | 6.75 |
| Crates—80@35c | 28.00 |
| Picking—80 crates@80c | 64.00 |
| Grading—80 crates@20c | 16.00 |
| Probable expense | 122.00 |
| Probable receipts, 80 crates@$3 | 240.00 |
| Probable added income from strawberries: | |
| One acre ($240 minus $122) | 118.00 |
| Two acres (two times $118) | 236.00 |
| Three acres (three times $118) | 354.00 |

TABLE 2.

Probable results of substituting strawberries for three acres of corn and one acre of tobacco

Reductions in returns from corn and tobacco:

| | | |
|---|---|---|
| 3 acres corn—@35 bu. per acre | | |
| grain—105 bu. @60c | $63.00 | |
| stover— 36 shocks @25c | 9.00 | |
| 1 acre tobacco—900 lbs. @14c | 126.00 | |
| | | $198.00 |
| Seed corn—½ bu. @$2 | $1.00 | |
| Tobacco fertilizer, canvas, spray material, etc. | 4.00 | |
| | | 5.00 |
| Reduction in income from corn and tobacco | | $193.00 |
| Added income—3 acres strawberries (Table 1) | | 354.00 |
| Increase in farm profits | | $161.00 |

**Heavy Versus Light Pruning in Young Orchard.** The observations of previous years upon this question have been continued and confirmed. As in the four seasons preceding 1924, the filler rows of trees with even numbers have been pruned much more heavily than the permanent or odd numbered rows.

Out of a total of 196 bushels of apples handpicked from 80 varieties in the orchard in 1924, 72 bushels were produced upon the filler rows, heavily pruned, while from practically the same number of permanent trees, lightly pruned, 124 bushels were gathered, or an increase of 72 per cent. in production in favor of the method of light pruning, notwithstanding the fact that in a few varieties the comparative results of light and heavy pruning were reversed.

**Early and Delayed Bearing of Fruit Trees.** Altho the apple orchard is now in its eleventh year, there are still a number of the 130 varieties and strains included in the planting which have not commenced to bear fruit. Among the nonproducers are such notably tardy-bearing kinds as Gravenstein and Northern Spy, which nevertheless have generally proved profitable market sorts when once production begins. Among the entire list of winter varieties, under conditions at the Experiment Station orchard, none has apparently surpassed Stayman for uniformly consistent production combined with vigor of growth and high quality.

The season has been a favorable one for peaches and 91 trees produced a total marketable yield of 203¾ bushels, or an average yield of 2.24 bushels. However, a number of these trees have never fully recovered their normal bearing capacity since the severe wrecking resulting from the sleet storm of three years ago.

From a total of 43 bearing plum trees, there was an average tree yield of 1.32 bushels and a total yield of 56.62 bushels.

**Grape Leaf-Hoppers.** Two species of these insects—*Erythroneura comes,* the variety octonotata, and *Erythroneura vulnerata,* have been found to do most of the mischief in Kentucky, tho several others are known to attack grape. The life-history and habits of these insects have been studied. Sprays to be effective must be applied when the insect is in the nymph stage and when the nymphs become numerous on the vine. The nymphs appear in greatest numbers at about the middle of July to the first of August. The nymphs are sensitive to nicotine sprays and may be killed by a solution of nicotine sulfate at a dilution of 1 part of the commercial 40 per cent nicotine sulfate to 1,400 parts of water. The solution is made by mixing one pint of the nicotine sulfate with 175 gallons of water. A dilution of one pint of nicotine sulfate to 200 gallons of water is nearly as effective as the stronger solution and may be applied with good results when the nymphs are not too far developed. The 1 to 1,400 solution killed 97 to 100 per cent of the nymphs of various sizes and the 1 to 1,600 killed 96.5 to 100 per cent of the nymphs of various sizes. The nicotine sulfate may be applied as a single solution or it may be mixed with Bordeaux mixture at the time this spray is being applied for fungus diseases. It is necessary to direct the spray against the under side of the leaves in order to hit the nymphs, as they live on that side of the leaves.

**Tobacco Black Root-Rot.** The past season, tobacco black root-rot (*Thielavia basicola*) was unusually severe. Approximately 1,000 packages of seed of Experiment Station strains of black root-rot resistant tobacco have been sent out for trial. The results of questionnaires and observations indicate that black root-rot caused damage in 65 per cent of the fields in which comparative tests of the resistant and ordinary strains were tested. Because of the method of distribution of seeds, this probably indicates closely the percentage of tobacco soils infected with this organism in the Burley section. Of those who grew the resistant strain this year and reported on it, 67 per cent will grow it exclusively.

Back crossing the $F_1$ generation with the susceptible parent having the disease qualities has been found valuable in quickly isolating resistant strains of a desirable type of tobacco. This is particularly valuable when Turkish tobacco is used as the resistant parent. The first cross has usually been made in the field and the back cross in the greenhouse during the winter. The next summer it is possible to obtain heterozygous resistant plants of the desired type. Further tests of the resistance of the commonly grown black tobacco varieties indicated that in a season like 1923 in heavily infected soil they would be nearly a complete failure.

**Tobacco Brown Root-Rot.** This root disease of tobacco is prevalent in both the burley and dark tobacco sections of Kentucky. It is characterized in some cases by completely stunting the plant as in a severe case of black root-rot and in others by rotting only a sufficient number of small rootlets so that altho the plant makes a fairly normal growth, yet it is quickly affected by periods of drouth when it may wilt badly. One strain of black root resistant burley (W) has been found to be particularly susceptible to this trouble as indicated by its decidedly inferior growth on corn land at the Experiment Station in comparison with other varieties and strains, and by the fact that in comparison on farms, it has been decidedly inferior in growth in about 5 per cent of the cases, to the local variety.

The cause of this disease has been studied and isolations from the rotting edge of small rootlets usually give Fusaria, but very often another organism has been isolated which thus far has remained sterile in culture. It is characterized by producing a brilliant wine-red color on "Bacto" agar in contrast with the fusaria which rarely produce color on this medium. In this medium, it also produces very small black sclerotia and the mycelium is from white to dark brown.

Inoculation tests on young seedlings of tobacco, red clover, alfalfa, alsike clover, radish, cabbage and onions, growing in test-tubes on nutrient agar, show conclusively that practically all species of Fusaria isolated from the roots of tobacco

and several other crop plants and weeds and also a group of named species of Fusaria, including those which cause wilt of cabbage, aster, flax, potato and tomato, are capable of penetrating these seedlings and causing their death in a very few days.

The results indicate that the Fusaria as a group are capable of attacking the new tissues of a wide range of plants, and suggest that they may live in the soil from year to year, not as saprophytes, as is generally suspected, but as weak parasites on a wide range of host plants.

Greenhouse inoculation on tobacco plants has so far shown that the majority of the Fusaria tested have no apparent effect on the growth of the roots or tops of tobacco plants. However, when a careful examination is made of the root systems of inoculated plants, an appreciable number of small rootlets are found to be dead. Re-isolations from the roots of two plants resulted in the development of the organism which was used for inoculation. The checks have produced perfectly healthy root systems. One organism, tentatively identified as *Fusarium bulbigenum* Cook and Massee, completely prevented the development of the two plants set in the pot inoculated with it. This organism is suspected of being the primary cause of the severe cases of brown root-rot.

**Bacterial Leaf-Spot of Tobacco.** The possibility of chewing tobacco acting as a source of plant bed contamination has been clearly demonstrated by chewing and spitting diseased tobacco on to young plants in the bed, and by steeping samples of tobacco in water and pouring the liquid on the plants. Tests indicate that the organisms are dead in tobacco one year old or more, as the use of such material has resulted in no plant bed infection. Canvas thoroly infected either with angular leaf-spot or wildfire organisms and put on this bed at seeding time did not result in infection. The redrying process which exposed the tobacco to temperatures of 155 to 170 degrees for forty minutes did not destroy the organisms. Seed treatment (1:1000 mercury bichloride for 15 minutes) was not effective in ridding seed of the organisms either in experi-

mental beds or in numerous beds on farms. In experimental beds, the diseases were completely controlled by using seed raised in the greenhouse or by using seed from a single apparently disease-free pod.

**Corn-Soybean Tests.** The corn-soybean tests described in previous reports were completed this year. August was dry and the competition of the beans reduced the yield of corn very materially. During the seven years in which these tests have been conducted, there have been two very good seasons for corn, two very poor ones, and three fair seasons. Even in the best corn years, the lightest planting of beans has reduced the yield of corn to some extent. In dry years, the reduction in yield has been very marked. The average yields for different methods of planting for the 7-year period are as follows:

| | Corn Yield per Acre Bus. | Soybeans Yield per Acre Bus. | Total Yield Bus. |
|---|---|---|---|
| Corn alone | 45.1 | ..... | 45.1 |
| Corn with beans in each hill of corn | 38.3 | 3.7 | 42.0 |
| Corn with 2 hills of beans to each hill of corn (4 yrs.) | 32.7 | 5.0 | 37.7 |
| Corn only, same 4 yrs | 43.5 | ..... | 43.5 |
| Alternate rows beans and corn in 36" rows (5 yr. average) | 20.7 | 10.2 | 30.9 |
| Corn only, same 5 yrs. | 37.3 | ..... | 37.3 |
| Beans drilled thick in corn rows (6 yr. average) | 26.6 | 10.8 | 37.4 |
| Corn only, same 6 yrs. | 45.5 | ..... | 45.5 |
| Beans only | ..... | 19.7 | 19.7 |

Standard varieties of corn have been used and it has been planted in hills $3\frac{1}{2}$x$3\frac{1}{2}$ feet apart and thinned to two

stalks per hill. The beans have averaged 3 plants per hill. Where two hills of beans have been grown to each hill of corn, one hill has been planted in each hill of corn and one between the hills. The average total yield of beans and corn where the lightest seeding of beans has been practiced is somewhat less than that of the corn alone. As the beans are usually worth more per bushel than corn, probably the total value in this case is about the same. However, this would be true only where the corn and beans are hogged down, as it is not practical to harvest soybeans in corn. The soybeans in the lightest seeding would add about 10 to 12 pounds of nitrogen per acre to the soil. Heavy seedings of soybeans are very injurious to corn, reducing both yield and quality very seriously. These experiments indicate that it is probably profitable to make a light seeding of soybeans in corn intended for hogging down, but that it will scarcely pay from the standpoint of fertility alone.

**Corn.** As corn so often suffers from drouth in Kentucky a test was made of the method of planting in rows twice the normal distance apart. Last year, the season was very favorable for corn and the ordinary method of planting gave large yields. The year 1924 was much drier and corn suffered considerably from drouth during August. However, the corn planted in the ordinary way outyielded that planted in the wide rows. The differences were not large, but as the plots were repeated six times, the results are significant. Yields for both years are as follows:

| | Ordinary Planting Bus. per Acre | Double-spaced rows Bus. per Acre |
|---|---|---|
| 1923 | 81.1 | 72.4 |
| 1924 | 68.3 | 65.1 |

**Corn Root-Rot Studies.** Studies have been continued to determine the effect on yield of selecting the smoothest and roughest ears from a lot of properly cured seed ears. Be-

ginning with a rough strain in 1922, and picking the roughest and smoothest ears, the smooth out-yielded the rough 39 per cent; in 1923, 13 per cent, and in 1924, 9.44 per cent. The smooth ears out-yielded the intermediate ears 1.5 per cent.

In the studies to determine a method by which corn seeds could be freed of pathogenic organisms, seeds soaked 20 hours in one part of quicklime in four parts of water and then treated 15 minutes in a 1:1000 solution of bichloride of mercury resulted in marked stimulation in germination, both in test-tubes of agar and in sand, and resulted in 93 per cent control of seed-borne organisms when tested on agar in test tubes. This treatment is very promising as a means of eliminating seed-borne organisms for experimental purposes without injuring the vigor of germination. It has not yet been determined whether this treatment completely kills the organisms or only retards their development, but it is likely that they are completely killed, as the long soaking in lime water macerates the seed coats slightly, making penetration by the bichloride solution easy. Lime water alone had apparently no effect in eliminating *F. moniliforme* from corn seeds.

A warm formaldehyde solution (1:250 at 40 degrees C.) in which seeds are soaked for 25 minutes, has been found very effective in ridding seeds of surface organisms. Seeds of tobacco, clovers, radish, etc., so treated may be germinated on agar and the seedlings transferred to test-tubes of agar with nearly 100 per cent of plants free from fungi and bacteria. This treatment is not effective against *F. moniliforme* in corn seeds.

**Clover.** Seeding experiments with clover begun in 1916 have been continued each year, but summer seeding on plots was found impracticable because of the attacks on young clover by grasshoppers. After a complete loss for three years in succession, no further trials were made and the experiments were confined to spring seeding with the following methods:

a. Sowing on frozen ground in early February.
b. Sowing on unfrozen ground in late February or early March.

c. Sowing on unfrozen ground in late February or early March, and using a light top dressing of manure.
d. Drilling with clover seed drill in late March or early April.
e. Broadcast sowing in late March or early April followed by harrow.

In only two cases has there been a failure to get a good stand of clover. For some unknown reason, the later seedings with a drill in 1916 were a failure, while in 1919, the seed sown February 3 on a heavy honeycomb freeze failed to make a good stand, probably because covered too deep. In several cases the clover killed during the following fall and winter due to drouth or severe heaving, but in no case was there any relation between the time of seeding and these occurrences. As nearly as possible the same amounts of seed have been used in all plots. The stand secured by drilling has averaged a little thicker in most seasons than the stands secured by the other methods.

**Growth of Crops in Soils Differing with Respect to Freedom from Disease.** Corn was grown in pots in the greenhouse in a virgin woods soil steamed and unsteamed; and in a soil from a continuous corn plot, steamed and unsteamed. Much better root systems were developed in the virgin soils and in the steamed cropped soil than in the unsteamed crop soil. Root systems in the virgin soils and in the steamed cropped soil were very largely free from lesions, clean and white; apparently individual roots had maintained themselves thruout the growth of the plants. Root systems in the unsteamed cropped soil were dark colored, badly rotted and, to a considerable extent, made up of newly formed roots, individual roots apparently not persisting during growth of the plants. Root systems were apparently equally free from disease in the virgin unsteamed, virgin steamed and in the cropped steamed soils. Application of fertilizer salts to the unsteamed cropped soils gave increased growth of root systems, but no greater freedom from disease.

**Soil Experiment Fields.** The fields now in operation are at Mayfield, Lone Oak, Hopkinsville, Greenville, Berea, Fariston and Campbellsville and the various fields on the Station farm

at Lexington. The Russellville field was discontinued December 31 of this year.

**Russellville Field.** Definite information was obtained from this field upon which to base recommendations for the management of the soils of the St. Louis limestone region.

Corn, soybeans, wheat and clover formed the main rotation on this field, the outstanding results of which are given in the following table:

| Treatment | Corn Average 10 years Bus. | Soybeans Average 11 years Pounds | Wheat Average 9 years Bus. | Clover Hay Average 9 years Pounds |
|---|---|---|---|---|
| No treatment | 28.9 | 1704 | 8.4 | 1250 |
| Manure | 32.3 | 2048 | 11.1 | 1410 |
| Manure and acid phosphate | 37.1 | 2431 | 13.2 | 2346 |
| Manure and rock phosphate | 35.8 | 2518 | 15.5 | 2606 |
| Manure, limestone and acid phosphate | 46.3 | 2770 | 18.3 | 3464 |
| Manure, limestone and rock phosphate | 45.2 | 2753 | 16.0 | 3400 |

The addition of potash or nitrogen, or both, to the fertilizers did not give enough increase in crops in any case, as an average of the period, to pay the cost of the addition.

Two rotations containing tobacco were used on this field; one clover, tobacco, corn, wheat, and the other clover, corn, tobacco and wheat. The second rotation was decidedly superior for tobacco, wheat and clover. The corn yield was practically the same in both rotations until last year, when it was decidedly better in the second.

**Lone Oak Field.** In the fall of 1923, this field was plowed because of heavy infestation with wild onions. After breaking in the fall and in the following spring, the field was disked or harrowed whenever onions appeared. This treatment was kept up until the middle of June when the field was planted to soybeans drilled at the rate of one and a half

bushels per acre, with the exception of two acres which had been planted to corn. After harvesting the corn and soybeans, the land was disked and allowed to lie until October 20, when wheat was seeded on the entire field. No onions could be found from the time the beans were planted until the time the wheat was sown. After the wheat was sown, a few onions appeared, estimated at about five plants to ten feet square. The wheat will be used as a cover crop and plowed under, when the land will be handled as in 1924, with the hope of complete eradication of the onions.

**Mayfield Field.** A part of the Mayfield experiment field was set aside for cotton work. A variety test was conducted upon land previously limed and treated with acid phosphate and on which alfalfa had been grown for years. No manure had been used on this land. The cotton was fertilized with 200 pounds of acid phosphate and 50 pounds of sulfate of potash per acre, one-half applied in the row, and one-half applied broadcast. Fifty pounds of nitrate of soda were applied at planting time and 50 pounds as a side-row dressing just after the cotton was thinned. Tests were made with six widely used varieties of cotton, the results being as follows:

| Variety | Yield per acre seed cotton, lbs. | Per cent at first picking |
|---|---|---|
| Tennessee Trice | 797 | 57.6 |
| Mississippi Trice | 736 | 42.9 |
| Express | 706 | 36.7 |
| Cleveland | 650 | 34.2 |
| Delfos | 597 | 36.7 |
| Acala | 475 | 19.9 |

Earliness of maturity is indicated by percentage yield for the first picking and from the results, it is seen that the earlier varieties made the best yields. For that reason, earliness is of prime importance in the growing of cotton in Kentucky, where at best the season will be somewhat short for the crop.

Fertilizer tests also were made with cotton and while it is unsafe to draw conclusions from a single year's results, it seems that manure is very effective on cotton. Acid phosphate on limed ground makes a good showing. Potash, in addition to lime and phosphate, seems to have hastened maturity, as well as largely increased the number of bolls. The use of a commercial form of nitrogen did not show any increase this year, but undoubtedly its use on somewhat poorer land would prove quite profitable. These tests will be continued for some time.

**Lexington Field.** The soil in this field has been kept in a good state of fertility and lime has had no appreciable effect on any crops except alfalfa and sweet clover.

An experiment was begun in 1920, using a rotation of corn, wheat and clover to obtain information as to the economic limit in the use of manure on bluegrass soils where good rotations are practiced. Manure was applied as follows:

1. Manure—4, 6, 8 and 10 tons on the clover sod and plowed under.
2. The same amounts on the plowed clover sod and disked in.
3. Manure—4, 6 and 8 tons on the wheat in early winter.
4. The same amounts on young clover soon after wheat harvest.
5. No manure.

Where manure was applied on the sod and plowed under, 4 tons was decidedly more effective than the larger applications, the increase being 6.3 bushels for the former and 4.5 bushels for each of the larger applications. Where manure was applied on the broken sod and disked in, it was 43 per cent more effective than when plowed in. The increases were 6.0, 8.3, 7.2 and 6.5 bushels, respectively for 4, 6, 8 and 10 tons of manure.

As an average of four years of wheat, the increase has been 3.2 bushels per acre when the manure was applied on the sod broken for corn; 1.86 bushels where it was applied on the broken sod and disked in, and 3.6 bushels where the manure was applied directly to the wheat in early winter. This experiment has not been in progress long enough to determine what the best average practice will be.

In the early history of the Experiment Station certain fertilizer experiments were conducted in which crops were grown continuously on the same land. An outstanding result was the large increase on corn from the use of potash, the average increase for six years being about 30 bushels per acre. These experiments were discontinued about 1900, when the land was seeded to bluegrass and used as pasture until 1914, at which time the old experiments were renewed, the old plots being exactly relocated. In continuous corn culture, the average increase for potash has been 3.9 bushels for a period of eight years. On another set of plots, the same fertilizer treatments were used, but a rotation of corn and soybeans was used, the cornstalks and soybean straw returned and a cover crop used. The average increase of corn in this rotation has been 0.4 of a bushel per acre for potash, while for soybeans it has been 1.2 bushels per acre. The increase for nitrogen and phosphorus on corn and soybeans has also been negligible. The experiments show that by proper soil management, commercial fertilizers are unnecessary for the ordinary farm crops on the better types of bluegrass soils. However, fertilizers will usually be profitable on tobacco unless the soil is the best of old bluegrass sod or a good clover sod.

In a rotation of tobacco for two years following a sod, wheat, then clover and bluegrass for three years, fertilizers have been profitable. A mixture of 200 pounds of acid phosphate, 100 pounds sulfate of potash and 200 pounds of nitrate of soda per acre, has increased the yield of tobacco an average of 250 pounds per acre as an average for seven years. The fertilizer cost about $15 per acre, while the increase in tobacco is worth about $50 per acre. Another interesting fact brought out in the tobacco fertilizer experiments is that 200 pounds of nitrate of soda per acre is about as effective on a sod as 15 to 20 tons of manure per acre.

Rotation experiments are in progress with tobacco in an effort to find a short rotation for tobacco. The general result has been that the shorter the rotation, the smaller the yield. The results also show a better yield of tobacco when it follows

clover or grass than when a crop of corn comes between the clover or grass and the tobacco.

**Nitrification Studies.** Determination of the amounts of nitrates in the crop rotation plots under wheat (surface soil) at the time of fall sampling, when the largest amounts were found, showed the following:

| | Oct. 21 1921 | Oct. 31 1922 | Nov. 1 1923 | Nov. 25 1924 |
|---|---|---|---|---|
| | Pounds $NO_3$ per 2,000,000 Lbs. Soil | | | |
| Avg. of the two corn, wheat clover plots | 180 | 169 | 12 | 43 |
| Corn, wheat, orchard grass plot | 178 | 96 | 8 | 35 |
| Tobacco, wheat, clover plot | 85 | 107 | 43 | 51 |
| Corn, wheat, soybeans (rows) plot | 164 | 72 | 10 | 37 |
| Corn, soybeans (rows) wheat plot | 104 | 83 | 35 | 32 |
| Corn, soybeans (solid) wheat plot | 129 | 50 | 32 | 27 |

Determination of nitrates found in fallow land (surface soil) after tobacco, hemp, oats, soybeans and corn have also been made and the amounts found at representative samplings are as follows:

| Crop preceding fallow | Nov. 1 1923 | Apr. 15 1924 | May 27 1924 | July 9 1924 |
|---|---|---|---|---|
| | Pounds $NO_3$ per 2,000,000 Lbs. Soil | | | |
| Tobacco | 44 | 41 | 114 | 195 |
| Hemp | 15 | 40 | 76 | 203 |
| Oats | 39 | 43 | 90 | 196 |
| Soybeans | 61 | 45 | 99 | 193 |
| Corn | 14 | 37 | 92 | 195 |

The crops were grown during 1923 and fallowing was done during the fall of 1923 and during 1924.

**Seed Inspection.** The total number of tests of all sorts made during the year was 6,948, of which 3,851 were for germination and 1,426 for purity. The total number of samples received was 3,097.

The seed law, enacted in 1916, does not provide funds for the enforcement of the act or for the conduct of the seed laboratory. In consequence, the utmost that the Experiment Station can attempt is the furnishing of information to farmers and the maintenance of educational work. Kentucky seed growers are often affected by the failure to adequately finance a seed control act and without the provision of funds there is danger that Kentucky may be used as a dumping ground for seeds not acceptable to states with laws adequately financed.

**Creamery and Tester's License.** Seven hundred and twenty cream station licenses have been issued during the year; 30 were renewal licenses for creameries, ice cream factories and milk plants operating in Kentucky; 11 for new plants; 29 for independent buyers of butter fat; 403 cream station renewals and 247 for new cream stations. At this time, there are 522 licensed stations which buy butter fat for the dairy plants in this state and for thirteen such plants in Ohio, Indiana, Illinois, Tennessee and West Virginia.

Thirty tester's license examinations were held; 6 at Lexington, 6 at Louisville, 6 at Cincinnati, 6 at Paducah, 1 at Owensboro, 1 at Franklin, 2 at Henderson, 1 at Bowling Green and 1 at Hardinsburg, and in addition five special examinations were given. Notices of these examinations were sent to 473 persons, of whom 298 or 63 per cent appeared. Of those present 77 per cent made a passing grade of 75 or higher.

There are 535 licensed testers in the state, of whom 401 hold renewal licenses granted July 1, 1924, and 134 are new operators licensed since that date. Licenses were issued to 114 new operators prior to July 1.

Inspection reports were made at 312 stations in 63 counties. Forty-three testers at these stations have been put on parole for some minor violation of the rules and regulations, with the understanding that at the next inspection any fail-

ure on their part to observe the rules and regulations would be sufficient cause for their appearance before the Examining Board. Four testers violating the law were brought before the Examining Board and the license of one suspended for sixty days; two had their licenses suspended for six months, after which time they may appear and take the tester's examination; and the license of the remaining one was permanently revoked.

Four suits were instituted in court for violation of the law. Of these, two were settled by the defendants paying fines amounting to $290, and the other two are still pending.

A total of 17,580 pieces of glassware were retested and 80 pieces (.45 per cent) rejected as inaccurate.

The fees received by the creamery and the tester's license section amounted to $5,893.28, with expenditures as follows:

| | |
|---|---|
| Salaries | $2,502.52 |
| Labor | 326.94 |
| Postage and stationery | 167.68 |
| Freight and express | 4.20 |
| Sundry supplies | 129.01 |
| Travel | 1,324.98 |
| Contingent | 36.12 |
| Total | $4,491.45 |

**Public Service Laboratories.** The department as a whole handled 44,742 samples and sterilized, assembled and sent out 28,042 specimen outfits.

Of the total examinations made, 42,943 were handled by the bacteriological laboratory and included Wassermann tests, examinations for tuberculosis, diphtheria, typhoid, gonorrhea, rabies, etc., and of waters, milk, cream and ice cream. Of these examinations, 12,322 were requested by state institutions, health departments, hospitals, etc.

The food samples examined totaled 1,472, consisting of 1,093 official food samples submitted by the inspectors from the Bureau of Food, Drugs and Hotels of the State Board of Health, and 379 unofficial samples received from various

sources. These included milk, cream, butter, canned fruit, tomatoes, baking powder, self-raising flour, carbonated beverages, etc.

A total of 330 samples were examined in the drug laboratory, 226 of which were official samples and 104 of an unofficial nature. Examinations were made of patent and proprietary medicines, disinfectants and insecticides, pharmaceuticals, veterinary remedies, waters, and for poison and prohibition cases.

The department has been called upon to make a large number of special investigations of a wide variety of specimens, these investigations often requiring the cooperation of two or more laboratories before a satisfactory solution of the problem could be arrived at.

Among the specimens for these special investigations, many of which were very interesting from a scientific standpoint or because of the history of the case, were a flour which showed the use of benzoyl peroxide in the bleaching process: a remedy for contagious abortion in cattle, which proved to be a fraudulent and worthless mixture of light brown sugar and wheat middlings; creek water, found to be contaminated by waste from a manufacturing plant to such an extent as to cause the death of large numbers of fish; water causing rapid corrosion of pipes in mine, sores on feet of donkeys used in the mine and rapid destruction of clothing worn by miners, all found to be due to sulfuric acid formed from oxidation of iron pyrites contained in coal; blood stains in suspected murder and rape cases, etc., etc. Remedies were suggested in cases where indicated, and in others, findings and testimony were placed before the proper authorities.

**Feed Control.** Kentucky farmers purchased during 1924, a little over 260,000 tons of commercial feeds, at an estimated retail price of fifteen million dollars. Of this amount, about 75 per cent was imported into the state and only about 25 per cent was produced in the state. The price paid for commercial feeds alone, not including whole grains and hays consumed in the state, based on the 1920 U. S. Census, equals about one-tenth of the value of the total livestock in the state.

Special investigation in conjunction with the federal department, in the substitution of flax plant by-products or refuse for alfalfa meal by manufacturers in Kentucky and those shipping into Kentucky, revealed the fact that manufacturers were using flax plant refuse as a substitute or as an adulterant. Prosecutions have resulted.

Investigations have also been made in the use of "grain screenings" in feeds made in the state and of those shipped into the state. It was found that elevators at grain stations were "reworking" the screenings by putting them thru several processes of separation and that in nearly every instance, this material was sold under the name of "ground grain screenings," varying in quality from a very wholesome material to a worthless and even dangerous feed. Kentucky has asked other states to join in a request to the Bureau of Federal Grain Supervision to take over the control and distribution of "grain screenings" with a view to grading or standardizing them in a manner similar to that under which grain is handled.

Chemical and microscopical analyses have been made of 1,003 samples of feed and the results reported to those concerned. Eleven suits for violation of the law have been instituted in the federal courts and fourteen in the state courts. Of the suits in the state courts, eleven have been completed and decided in favor of the Experiment Station.

**Fertilizer Control.** The brands of fertilizer registered for sale in the state numbered 729, practically all of which were analyzed. Additional analyses were made of 739 samples collected by inspectors and of 53 samples sent in by farmers and others. The stamps issued represented a tonnage of 85,419½, and the tags numbered 2,387,000.

**New Projects.** Projects initiated during the year are—

A farm organization study in the "Jackson Purchase" area of western Kentucky.

The flea beetles of tobacco.

Lamb feeding investigations, to determine the feasibility of feeding late native lambs for the market.

Barley feeding experiments to determine the best way to feed barley to fattening hogs.

Sanitation of premises and equipment for hogs.

White salt versus smoked salt in curing and keeping pork.

The use of condensed and granulated buttermilk to supplement the laying mash for hens.

A comparison of oyster shell, ground limestone and pearl grit as sources of shell-forming material in hens.

**Changes in Staff.** The personnel of the Experiment Station, other than clerical assistants, is shown by departments on page 2 of this report. The appointments and resignations for the year are as follows:

**Appointments:**

J. D. Foster, inspector in charge creamery license section. February 1.

W. J. Nungester, assistant bacteriologist, department of public service laboratories. March 1.

R. E. Tolle, inspector of feeds and fertilizers. April 21.

Walter S. Meng, inspector, creamery license section. April 14.

Roger W. Jones, superintendent Robinson Sub Station, June 19.

C. H. Burrage, forester, Robinson Sub Station, August 25.

Maurice L. Boevers, assistant, department of veterinary science. September 1.

C. S. Waltman, assistant horticulturist. September 1.

Earl K. Borman, assistant bacteriologist, department of public service laboratories. September 17.

P. H. Senn, microscopist, department of feed control. October 1.

S. J. Lowry, superintendent, Western Kentucky Sub Station, December 1.

**Resignations:**

A. J. Steiner, assistant veterinarian. July 1.

Jessie Terry, seed analyst. July 1.

R. A. Stevenson, nursery and seed inspector. September 1.

W. J. Nungester, assistant bacteriologist, department of public service laboratories. September 15.

Walter S. Meng, inspector, creamery license section. October 11.

Ethel Hopphan, serologist, department of public service laboratories. December 1.

**Publications.** The following publications have been issued during the year:

**Bulletins:**

**No.**

252. Calcium Metabolism in the Laying Hen, II. G. D. Buckner, J. Holmes Martin and A. M. Peter. March, 1924.

253. A Study of Farm Organization and Management in Mason and Fleming Counties. W. D. Nicholls, C. U. Jett and Z. L. Galloway. June, 1924.

254. The Grape Leafhoppers of Bluegrass Kentucky. H. H. Jewett. August, 1924.

255. Strawberries and Farm Profits. J. B. Hutson. December, 1924.

256. Analyses of Commercial Fertilizers. H. E. Curtis, H. R. Allen and Lelah Gault. December, 1924.

**Circulars:**

32. Marls for Liming Soils. S. C. Jones. April, 1924.

33. Bacillary White Diarrhea. A. J. Steiner. April, 1924.

34. Potato Growing in Kentucky. John S. Gardner and C. W. Mathews. June, 1924.

**Reports:**

Thirty-Sixth Annual Report of the Experiment Station —1923. Thomas P. Cooper.

**Scientific Papers (In Print):**

Chemical analyses of the soils of Garrard County. S. D. Averitt. Advance sheets—Field Operations of the Bureau of Soils, 1912. Government Printing Office, Washington, 1924.

The association of manganese with vitamins. J. S. McHargue. Journ. Agricultural Research. Vol. 27, No. 6. February 9, 1924.

The determination of nitrate and ammonia in nitrogenous materials. O. M. Shedd. Journ. Agricultural Research. Vol. 28, No. 6. May 10, 1924.

The preparation from tobacco of a solution for spraying. O. M. Shedd and A. J. Olney. Journ. Economic Entomology. Vol. 17, No. 6. December, 1924.

Chemical analyses of the soils of Muhlenburg County. S. D. Averitt. Advance sheets—Field Operations of the Bureau of Soils. 1920. Government Printing Office, Washington, 1924.

Research and its relations. Presidential address. D. J. Healy. Kentucky Medical Journal. December, 1924.

Swine diseases. W. W. Dimock and D. J. Healy. Annual report of the Ohio State Medical Association, 1924.

History of a Kentucky Jersey herd. J. J. Hooper. Jersey Bulletin. February 27, 1924.

The escutcheon, the finger print of cattle. J. J. Hooper. Jersey Bulletin. July 2, 1924.

Sex of calves carried over unusually long gestation period. J. J. Hooper, Breeders' Gazette. September 25, 1924.

Sex of over-term calves. J. J. Hooper and J. W. Nutter. Journ. of Heredity. Vol. XV., No. 11. November, 1924.

Mashless rations. J. Holmes Martin. Poultry Science. October, 1924.

The number of generations necessary for the power of aerobic growth by Bacterium abortus (Bang) A. H. Harms. Journal of Bacteriology. May, 1924.

Some facts concerning the feeding stuffs law of Kentucky and suggestions to the feeder. J. D. Turner. Circular.

Nitrogen in rainwater at different points in Kentucky. J. F. Freeman. Journal American Society of Agronomy. June, 1924.

Sulfur in rainfall at different points in Kentucky. E. M. Johnson. Journal American Society of Agronomy. June, 1924.

The infection of tobacco plant beds by spitting. W. D. Valleau. Science. April 11, 1924.

Angular leaf-spot and wildfire infection of tobacco plant beds by spitting. W. D. Valleau. Phytopathology January, 1924. (Abstract).

Studies on seed infection, ear types, yield and the isolation of strains of corn showing specific disease reaction in the germinator. W. D. Valleau. Phytopathology. January, 1924. (Abstract).

The following papers have been prepared this year, but have not yet appeared in print:

The significance of the occurrence of copper, iron, manganese and zinc in some mollusks and crustaceans. J. S. McHargue. Read at the annual meeting of the American Chemical Society, Ithaca, N. Y., September 8-13, 1924.

The significance of the occurrence of copper, manganese and zinc in forage crops and cereals. J. S. McHargue. Read at the annual meeting of the American Chemical Society, Ithaca, N. Y., September 8-13, 1924.

Chemical studies of the oviduct of the hen. G. Davis Buckner, J. Holmes Martin and A. M. Peter. Accepted by the American Journal of Physiology for publication in the issue of January, 1925.

The relation of calcium restriction to the hatchability of eggs. G. Davis Buckner, J. Holmes Martin and A. M. Peter. Accepted by the American Journal of Physiology for publication in the issue of February, 1925.

Concerning the mode of transference of calcium from the shell of the hen's egg to the embryo during incubation. G. Davis Buckner, J. Holmes Martin and A. M. Peter. Submitted to the Journal of Biological Chemistry.

Comparative analyses of the feces of laying hens with and without a calcium supplement in the diet. G. Davis Buckner, J. Holmes Martin and A. M. Peter. Submitted to Poultry Science.

Eberthella viscosa (Bact. viscosum equi); etiological factor in joint ill. Ethel M. Snyder. Accepted by Journ. Vet. Medical Association for publication in the issue of January, 1925.

The utilization of legumes in rotations in the Middle West. Ralph Kenney. Read before the annual meeting of the American Society of Agronomy, November 11, 1924.

Mineral mixture as a supplement in hogging down corn. E. J. Wilford. Read at the meeting of the American Society of Animal Production, 1924.

**Library.** The total accessions at the close of the year amounted to 10,478, representing an addition during the year of 916 volumes. Subscriptions covered 114 domestic and 33 foreign periodicals.

## KENTUCKY AGRICULTURAL EXPERIMENT STATION

**In Account with the United States Appropriations, 1923-24:**

| | Hatch Fund | Adams Fund |
|---|---|---|
| Receipts from the Treasurer of the United States, as per appropriations for fiscal year ending June 30, 1924, under acts of Congress approved March 3, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund) | $15,000.00 | $15,000.00 |
| Expenditures: | | |
| By Salaries | $15,000.00 | $15,000.00 |
| Labor | | |
| Stationery and office supplies | | |
| Scientific supplies, consumable | | |
| Feeding stuffs | | |
| Sundry supplies | | |
| Fertilizers | | |
| Communication service | | |
| Travel expenses | | |
| Transportation of things | | |
| Publications | | |
| Heat, light, water and power | | |
| Furniture, furnishings and fixtures | | |
| Library | | |
| Scientific equipment | | |
| Livestock | | |
| Tools, machinery and appliances | | |
| Buildings and land | | |
| Contingent expenses | | |
| Balance | | |
| Total | $15,000.00 | $15,000.00 |

*We, the undersigned,* duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year ended June 30, 1924; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was nothing on the Hatch Fund and nothing on the Adams Fund; that the receipts for the year from the Treasurer of the United States were $15,000.00 under the act of Congress of March 2, 1887, and $15,000.00 under the act of Congress of March 16, 1906, and the corresponding disbursements $15,000.00 and $15,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, leaving balances of nothing and nothing.

*And we further certify* that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887, and March 16, 1906, and in accordance with the terms of said acts, respectively.

Signed:

H. M. Froman,
F. M. McKee,
Enoch Grehan,
*Auditors*

Attest:
(Seal)

Jane J. Nichols,
*Custodian of the Seal.*

**METEOROLOGICAL SUMMARIES**

**For the Year 1924**

Compiled from the Records of the U. S. Weather Bureau Station, Lexington, Ky.

ANNUAL METEOROLOGICAL SUMMARY

| Month | Temperature, Degrees Fahrenheit | | | | | | | Relative Humidity Per cent 7 a. m. | Precipitation, in Inches | | | | Per cent of Sunshine | Wind | | | | | Number of Days | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | | Extreme | | | | | | | | | | Average Hourly Velocity | Prevailing Direction | Maximum For 5 mins. | | | Gales, 40 miles per hour or over | Clear | Partly Cloudy | Cloudy | Precipitation of .01 inch or more | With trace or more of snow | Thunderstorms | Dense fog | Max. Temp. | | Min. Temp. | |
| | Maximum | Minimum | Monthly | Maximum | Date | Minimum | Date | | Total | Maximum in 24 hours | Date | Total Snowfall, Ins. | | | | Velocity | Direction | Date | | | | | | | | 90 deg. or above | Freezing or below | Freezing or below | Zero or below |
| January | 38.0 | 21.0 | 29.5 | 56 | 29 | -6 | 6 | 83 | 5.09 | 2.14 | 2-3 | 0.7 | 45 | 15.3 | SW | 42 | W | 11 | 2 | 10 | 8 | 13 | 11 | 8 | 0 | 0 | 0 | 11 | 25 | 3 |
| February | 39.8 | 26.9 | 33.4 | 65 | 3 | 14 | 7 | 85 | 2.40 | 1.70 | 18-19 | 3.0 | 21 | 14.6 | SW | 38 | SW | 5 | 0 | 3 | 6 | 20 | 10 | 11 | 0 | 5 | 0 | 6 | 24 | 0 |
| March | 46.2 | 32.0 | 39.1 | 72 | 29 | 20 | 16 | 82 | 2.42 | 1.02 | 28-29 | 2.4 | 50 | 14.7 | NW | 66 | SW | 29 | 1 | 9 | 3 | 19 | 10 | 9 | 2 | 0 | 0 | 0 | 17 | 0 |
| April | 64.6 | 45.2 | 54.9 | 82 | 15 | 25 | 1 | 74 | 3.75 | 1.38 | 17-18 | T | 44 | 14.4 | SW | 58 | SW | 21 | 2 | 8 | 12 | 10 | 14 | 2 | 2 | 0 | 0 | 0 | 2 | 0 |
| May | 67.3 | 49.2 | 58.2 | 84 | 7 | 42 | 1 | 75 | 3.64 | 0.77 | 19-20 | 0 | 37 | 13.1 | SW | 64 | SW | 24 | 5 | 5 | 12 | 14 | 15 | 0 | 8 | 1 | 0 | 0 | 0 | 0 |
| June | 81.6 | 64.5 | 73.0 | 92 | 20 | 53 | 2 | 83 | 4.04 | 1.05 | 22-23 | 0 | 43 | 10.7 | SW | 48 | SW | 29 | 1 | 7 | 15 | 8 | 15 | 0 | 12 | 1 | 2 | 0 | 0 | 0 |
| July | 81.7 | 64.8 | 73.2 | 90 | 22 | 53 | 3 | 78 | 2.77 | 1.71 | 12-13 | 0 | 58 | 10.1 | SW | 38 | SW | 12 | 0 | 15 | 11 | 5 | 9 | 0 | 6 | 0 | 0 | 0 | 0 | 0 |
| August | 84.8 | 65.4 | 75.1 | 94 | 31 | 54 | 14 | 82 | 2.28 | 0.47 | 6-7 | 0 | 63 | 10.7 | SW | 39 | W | 6 | 0 | 16 | 11 | 4 | 8 | 0 | 6 | 1 | 8 | 0 | 0 | 0 |
| September | 72.4 | 55.0 | 63.7 | 88 | 1 | 40 | 30 | 84 | 3.89 | 1.15 | 21-22 | 0 | 45 | 12.6 | SE | 48 | W | 21 | 2 | 10 | 9 | 11 | 11 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| October | 72.0 | 52.7 | 62.4 | 80 | 15 | 34 | 23 | 65 | 0.11 | 0.10 | 31 | 0 | 68 | 11.0 | NE | 36 | SW | 31 | 0 | 21 | 4 | 6 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| November | 53.0 | 37.0 | 45.0 | 74 | 4 | 21 | 29 | 80 | 1.32 | 0.51 | 21 | 0.8 | 32 | 13.6 | SW | 40 | SW | 6 | 1 | 7 | 7 | 16 | 10 | 6 | 0 | 4 | 0 | 1 | 11 | 0 |
| December | 42.3 | 25.6 | 34.0 | 68 | 17 | 3 | 25 | 84 | 5.59 | 2.92 | 7-8 | 1.8 | 41 | 14.4 | SW | 48 | SW | 8 | 3 | 10 | 8 | 13 | 10 | 4 | 2 | 0 | 0 | 5 | 21 | 0 |
| The Year | 62.0 | 44.9 | 53.5 | 94 | Aug. 31 | -6 | Jan. 6 | 80 | 36.81 | 2.92 | Dec 7-8 | 8.7 | 44 | 12.9 | SW | 66 | SW | Mar. 29 | 17 | 121 | 106 | 129 | 125 | 40 | 43 | 13 | 10 | 27 | 100 | 2 |

## MONTHLY AND ANNUAL MEAN TEMPERATURE

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1872 | | | | | | | | | | | 37 | 27 | |
| 1873 | 30 | 35 | 42 | 53 | 66 | 74 | 75 | 74 | 67 | 53 | 40 | 39 | 54.0 |
| 1874 | 36 | 38 | 44 | 46 | 66 | 77 | 78 | 75 | 71 | 57 | 45 | 38 | 56.0 |
| 1875 | 27 | 29 | 42 | 49 | 64 | 72 | 76 | 71 | 64 | 52 | 43 | 43 | 52.7 |
| 1876 | 41 | 39 | 41 | 52 | 65 | 72 | 77 | | | | | | |
| 1887 | | | | | | | | | | | 44 | 35 | |
| 1888 | 31 | 36 | 41 | 56 | 63 | 72 | 76 | 74 | 63 | 51 | 46 | 37 | 54.0 |
| 1889 | 37 | 32 | 46 | 55 | 63 | 69 | 75 | 72 | 65 | 52 | 43 | 50 | 55.0 |
| 1890 | 44 | 45 | 39 | 56 | 63 | 77 | 76 | 71 | 67 | 56 | 49 | 37 | 56.6 |
| 1891 | 37 | 41 | 40 | 57 | 62 | 76 | 73 | 73 | 72 | 55 | 43 | 43 | 56.0 |
| 1892 | 28 | 41 | 39 | 54 | 63 | 76 | 75 | 75 | 68 | 57 | 41 | 33 | 54.1 |
| 1893 | 33 | 36 | 43 | 57 | 61 | 72 | 79 | 74 | 70 | 57 | 43 | 37 | 54.4 |
| 1894 | 38 | 34 | 49 | 54 | 62 | 75 | 76 | 76 | 71 | 58 | 41 | 37 | 55.9 |
| 1895 | 28 | 23 | 43 | 56 | 62 | 75 | 73 | 76 | 73 | 52 | 45 | 37 | 53.7 |
| 1896 | 34 | 35 | 38 | 62 | 71 | 72 | 75 | 75 | 67 | 54 | 48 | 38 | 55.9 |
| 1897 | 30 | 37 | 48 | 53 | 59 | 72 | 76 | 74 | 72 | 64 | 46 | 37 | 55.7 |
| 1898 | 38 | 36 | 49 | 50 | 65 | 74 | 76 | 76 | 72 | 56 | 43 | 33 | 55.8 |
| 1899 | 34 | 24 | 42 | 56 | 67 | 75 | 77 | 77 | 68 | 61 | 48 | 33 | 55.1 |
| 1900 | 36 | 31 | 39 | 55 | 66 | 72 | 77 | 79 | 73 | 65 | 45 | 37 | 56.3 |
| 1901 | 34 | 29 | 44 | 49 | 63 | 74 | 80 | 74 | 67 | 58 | 40 | 31 | 53.6 |
| 1902 | 32 | 25 | 45 | 53 | 68 | 71 | 77 | 74 | 67 | 59 | 53 | 34 | 54.8 |
| 1903 | 32 | 36 | 50 | 53 | 68 | 68 | 77 | 74 | 70 | 57 | 40 | 28 | 54.4 |
| 1904 | 30 | 31 | 46 | 48 | 64 | 72 | 74 | 74 | 69 | 57 | 44 | 34 | 53.5 |
| 1905 | 24 | 25 | 49 | 54 | 66 | 72 | 75 | 74 | 68 | 55 | 44 | 35 | 53.5 |
| 1906 | 37 | 32 | 36 | 57 | 64 | 72 | 74 | 76 | 71 | 55 | 45 | 36 | 54.5 |
| 1907 | 40 | 32 | 52 | 45 | 59 | 69 | 76 | 73 | 68 | 53 | 42 | 37 | 53.8 |
| 1908 | 33 | 33 | 50 | 55 | 65 | 72 | 76 | 75 | 72 | 58 | 48 | 38 | 56.1 |
| 1909 | 37 | 41 | 43 | 54 | 62 | 73 | 73 | 74 | 66 | 53 | 53 | 28 | 54.6 |
| 1910 | 32 | 31 | 54 | 54 | 59 | 69 | 75 | 73 | 70 | 60 | 40 | 29 | 53.7 |
| 1911 | 38 | 40 | 43 | 52 | 70 | 74 | 76 | 76 | 72 | 58 | 40 | 41 | 56.6 |
| 1912 | 23 | 28 | 39 | 57 | 65 | 69 | 75 | 72 | 70 | 59 | 44 | 26 | 53.1 |
| 1913 | 42 | 33 | 44 | 53 | 65 | 73 | 78 | 77 | 69 | 56 | 49 | 38 | 56.5 |
| 1914 | 37 | 29 | 40 | 54 | 66 | 76 | 78 | 75 | 67 | 59 | 46 | 30 | 54.6 |
| 1915 | 32 | 40 | 36 | 59 | 62 | 70 | 74 | 70 | 70 | 60 | 49 | 36 | 54.8 |
| 1916 | 40 | 33 | 41 | 52 | 67 | 69 | 78 | 76 | 67 | 58 | 47 | 34 | 55.2 |
| 1917 | 35 | 32 | 44 | 54 | 57 | 70 | 74 | 74 | 67 | 50 | 44 | 25 | 52.3 |
| 1918 | 20 | 38 | 49 | 52 | 69 | 72 | 73 | 79 | 62 | 61 | 44 | 43 | 55.2 |
| 1919 | 37 | 36 | 46 | 54 | 62 | 76 | 79 | 74 | 72 | 64 | 45 | 31 | 56.3 |
| 1920 | 30 | 33 | 45 | 50 | 62 | 71 | 74 | 72 | 70 | 62 | 43 | 36 | 54.1 |
| 1921 | 37 | 38 | 55 | 58 | 65 | 76 | 80 | 75 | 73 | 57 | 48 | 39 | 58.4 |
| 1922 | 33 | 38 | 47 | 57 | 68 | 75 | 76 | 75 | 73 | 61 | 47 | 39 | 57.3 |
| 1923 | 39 | 32 | 43 | 53 | 63 | 74 | 77 | 74 | 69 | 56 | 45 | 45 | 55.8 |
| 1924 | 30 | 33 | 39 | 55 | 58 | 73 | 73 | 75 | 64 | 62 | 45 | 34 | 53.5 |

## TEMPERATURE EXTREMES

| Month. | Highest | Year | Day | Lowest | Year | Day |
|---|---|---|---|---|---|---|
| January | 72 | 1906 | 21 | —14 | 1918 | 12 |
| February | 75 | 1918 | 28 | —20 | 1899 | 13 |
| March | 85 | 1910 | 24 | — 1 | 1873 | 4 |
| April | 88 | 1915 | 25 | 15 | 1875 | 18 |
| May | 93 | 1911 | 28 | 30 | 1876 | 1 |
| June | 99 | 1914 | 27 | 40 | 1910 | 3 |
| July | 102 | 1901 | 22 | 51 | 1891 | 9 |
| August | 100 | 1918 | 6 | 46 | 1915 | 31 |
| September | 98 | 1899 | 6 | 32 | 1899 | 30 |
| October | 89 | 1919 | 2 | 21 | 1873 | 29 |
| November | 78 | 1895 | 7 | 2 | 1872 | 29 |
| December | 71 | 1875 | 31 | — 9 | 1917 | 10 |

## MONTHLY AND ANNUAL PRECIPITATION

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Ann. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1872 | | | | | | | | | | | 1.21 | 3.30 | |
| 1873 | 2.53 | 4.05 | 3.73 | 2.89 | 6.05 | 4.49 | 3.37 | 2.94 | 1.60 | 5.47 | 1.92 | 4.48 | 43.52 |
| 1874 | 5.41 | 4.89 | 5.90 | 6.81 | 0.79 | 3.55 | 6.26 | 1.57 | 2.89 | 0.92 | 4.27 | 3.83 | 47.09 |
| 1875 | 2.61 | 3.12 | 6.18 | 2.06 | 2.43 | 4.16 | 11.24 | 0.62 | 1.72 | 2.37 | 5.87 | 3.68 | 46.06 |
| 1876 | 6.06 | 1.66 | 3.63 | 4.20 | 2.16 | 4.13 | 3.84 | | | | | | |
| 1887 | | | | | | | | | | | 3.02 | 2.71 | |
| 1888 | 4.39 | 2.93 | 5.82 | 3.17 | 3.29 | 2.97 | 4.21 | 8.76 | 1.22 | 3.02 | 5.15 | 1.88 | 46.81 |
| 1889 | 5.66 | 1.78 | 1.63 | 1.52 | 3.53 | 3.49 | 5.82 | 1.15 | 6.79 | 3.06 | 5.34 | 1.73 | 41.50 |
| 1890 | 5.34 | 8.13 | 9.91 | 3.59 | 4.71 | 7.43 | 3.14 | 7.32 | 1.82 | 2.38 | 3.54 | 4.05 | 61.36 |
| 1891 | 4.70 | 4.36 | 7.63 | 1.85 | 1.17 | 5.33 | 3.23 | 6.48 | 1.26 | 1.33 | 5.38 | 2.82 | 45.51 |
| 1892 | 2.35 | 3.10 | 4.01 | 6.57 | 5.32 | 3.81 | 6.22 | 3.28 | 4.10 | 0.45 | 3.72 | 3.03 | 45.96 |
| 1893 | 2.10 | 4.44 | 3.30 | 5.81 | 3.88 | 4.24 | 3.11 | 1.86 | 2.25 | 5.59 | 3.36 | 2.61 | 42.55 |
| 1894 | 3.58 | 3.33 | 2.13 | 4.19 | 3.81 | 4.44 | 0.87 | 3.67 | 4.05 | 1.40 | 1.38 | 3.45 | 36.32 |
| 1895 | 5.60 | 0.52 | 2.79 | 3.17 | 4.05 | 2.93 | 5.07 | 1.56 | 0.33 | 1.28 | 2.52 | 5.50 | 35.32 |
| 1896 | 1.25 | 3.15 | 5.41 | 0.40 | 3.20 | 3.74 | 10.39 | 3.37 | 4.25 | 1.27 | 4.30 | 2.56 | 43.29 |
| 1897 | 2.59 | 6.33 | 6.55 | 5.80 | 4.48 | 4.77 | 4.34 | 3.21 | 0.80 | 0.38 | 4.83 | 5.11 | 49.19 |
| 1898 | 9.56 | 2.20 | 8.18 | 3.29 | 6.13 | 7.94 | 5.72 | 2.99 | 3.55 | 5.27 | 2.89 | 2.80 | 60.52 |
| 1899 | 6.69 | 2.84 | 8.61 | 2.16 | 3.63 | 2.55 | 0.97 | 4.18 | 1.90 | 2.09 | 1.70 | 2.92 | 40.24 |
| 1900 | 2.13 | 3.17 | 1.98 | 1.23 | 3.54 | 2.19 | 2.80 | 5.75 | 1.85 | 0.79 | 6.38 | 1.86 | 33.67 |
| 1901 | 1.49 | 0.62 | 2.23 | 4.52 | 2.67 | 3.70 | 2.61 | 3.74 | 2.18 | 1.33 | 1.73 | 3.50 | 30.32 |
| 1902 | 4.77 | 0.90 | 2.92 | 1.27 | 2.43 | 5.19 | 2.33 | 1.89 | 2.60 | 2.11 | 3.09 | 6.60 | 36.10 |
| 1903 | 1.68 | 6.16 | 3.24 | 3.29 | 1.75 | 2.71 | 2.62 | 1.49 | 0.81 | 2.12 | 2.84 | 1.99 | 30.70 |
| 1904 | 1.92 | 2.38 | 4.75 | 3.08 | 2.60 | 2.51 | 3.13 | 2.44 | 1.71 | 0.57 | 0.53 | 3.10 | 28.72 |
| 1905 | 2.04 | 2.13 | 5.87 | 2.87 | 5.54 | 3.31 | 4.94 | 4.11 | 3.20 | 3.45 | 3.58 | 4.13 | 45.17 |
| 1906 | 2.29 | 1.84 | 6.45 | 1.11 | 3.15 | 4.68 | 3.89 | 4.92 | 5.03 | 0.74 | 3.95 | 4.54 | 42.59 |
| 1907 | 9.06 | 1.89 | 4.13 | 1.83 | 3.89 | 3.65 | 4.42 | 2.07 | 2.72 | 2.76 | 2.67 | 2.28 | 41.37 |
| 1908 | 1.85 | 4.81 | 8.17 | 4.99 | 4.20 | 2.12 | 3.60 | 2.98 | 0.38 | 0.72 | 1.65 | 2.13 | 37.60 |
| 1909 | 3.35 | 6.86 | 3.97 | 6.72 | 4.15 | 5.41 | 5.98 | 1.26 | 4.88 | 2.05 | 1.96 | 2.77 | 49.36 |
| 1910 | 4.46 | 4.11 | 0.46 | 4.22 | 6.24 | 5.92 | 7.66 | 4.15 | 7.92 | 1.67 | 1.72 | 2.81 | 51.34 |
| 1911 | 2.44 | 2.21 | 2.31 | 4.46 | 1.07 | 3.01 | 0.92 | 2.84 | 4.37 | 3.67 | 3.84 | 6.20 | 37.34 |
| 1912 | 1.78 | 2.50 | 4.36 | 6.89 | 5.11 | 2.15 | 4.70 | 3.23 | 2.09 | 0.51 | 1.02 | 3.66 | 38.00 |
| 1913 | 10.35 | 2.61 | 6.04 | 2.41 | 4.32 | 3.29 | 2.43 | 1.00 | 1.76 | 3.40 | 4.00 | 2.74 | 44.35 |
| 1914 | 2.50 | 3.87 | 2.24 | 2.23 | 1.65 | 4.77 | 2.63 | 4.69 | 1.82 | 5.32 | 1.62 | 4.40 | 37.74 |
| 1915 | 4.38 | 1.12 | 1.49 | 0.65 | 7.23 | 3.20 | 5.72 | 6.03 | 3.74 | 0.81 | 3.90 | 6.67 | 44.94 |
| 1916 | 5.65 | 3.40 | 3.30 | 1.01 | 2.92 | 5.33 | 1.72 | 2.34 | 2.75 | 2.04 | 1.25 | 3.63 | 35.34 |
| 1917 | 5.67 | 2.12 | 5.48 | 3.97 | 3.51 | 3.54 | 2.80 | 1.94 | 2.46 | 2.36 | 1.03 | 1.97 | 36.85 |
| 1918 | 4.46 | 1.92 | 1.55 | 2.09 | 4.13 | 3.61 | 2.01 | 2.68 | 1.41 | 4.57 | 2.24 | 4.83 | 35.50 |
| 1919 | 2.48 | 1.61 | 3.71 | 3.51 | 6.38 | 4.49 | 2.28 | 2.39 | 1.12 | 7.95 | 8.50 | 6.70 | 51.12 |
| 1920 | 5.26 | 2.11 | 4.62 | 6.42 | 2.51 | 2.39 | 1.73 | 6.71 | 4.88 | 2.75 | 2.22 | 1.40 | 43.00 |
| 1921 | 3.24 | 2.62 | 5.06 | 3.28 | 1.60 | 2.16 | 1.04 | 3.88 | 5.10 | 2.46 | 6.89 | 5.74 | 43.07 |
| 1922 | 1.87 | 3.12 | 7.75 | 4.46 | 3.10 | 2.44 | 2.13 | 2.20 | 5.99 | 1.25 | 0.88 | 5.67 | 40.86 |
| 1923 | 6.63 | 4.40 | 4.65 | 5.43 | 1.66 | 3.55 | 5.01 | 4.02 | 1.51 | 0.56 | 2.71 | 6.50 | 46.63 |
| 1924 | 5.00 | 2.60 | 2.42 | 3.75 | 3.04 | 4.04 | 2.77 | 2.28 | 3.89 | 0.11 | 1.32 | 5.95 | 36.81 |

## EXTREMES OF PRECIPITATION AND WIND

| Month. | PRECIPITATION | | | WIND | | | |
|---|---|---|---|---|---|---|---|
| | Greatest in 24 hrs. | Year | Day | Max. Vel. | Dir. | Year | Day |
| January | 3.50 | 1913 | 11 | 60 | sw | 1891* | 1 |
| February | 3.04 | 1909 | 23-24 | 60 | sw | 1890* | 25 |
| March | 3.61 | 1913 | 25-26 | 68 | sw | 1919 | 17 |
| April | 3.24 | 1909 | 29-30 | 64 | sw | 1909 | 29 |
| May | 2.61 | 1898 | 6-7 | 60 | nw | 1889* | 12 |
| June | 4.45 | 1898 | 26-27 | 60 | n | 1890* | 29 |
| July | 4.02 | 1875 | 11-12 | 58 | nw | 1915 | 30 |
| August | 2.98 | 1915 | 1-2 | 72 | s | 1918 | 6 |
| September | 5.45 | 1922 | 3 | 68 | w | 1889 | 8 |
| October | 2.32 | 1893 | 3-4 | 50 | nw | 1904* | 21 |
| November | 3.95 | 1919 | 25-26 | 62 | s | 1895* | 26 |
| December | 3.63 | 1919 | 6 | 60 | sw | 1895* | 26 |

*Also in subsequent years.